



US005935293A

**United States Patent** [19]**Detering et al.**[11] **Patent Number:** **5,935,293**[45] **Date of Patent:** **\*Aug. 10, 1999**[54] **FAST QUENCH REACTOR METHOD**[75] **Inventors:** **Brent A. Detering; Alan D. Donaldson; James R. Fincke; Peter C. Kong; Ray A. Berry**, all of Idaho Falls, Id.[73] **Assignee:** **Lockheed Martin Idaho Technologies Company, Idaho Falls, Id.**[\*] **Notice:** This patent is subject to a terminal disclaimer.[21] **Appl. No.:** **09/076,922**[22] **Filed:** **May 12, 1998****Related U.S. Application Data**

[63] Continuation-in-part of application No. 08/404,395, Mar. 14, 1995, Pat. No. 5,749,937.

[51] **Int. Cl.<sup>6</sup>** ..... **C22B 4/04; C22B 4/06**[52] **U.S. Cl.** ..... **75/10.19; 75/10.21; 75/399; 420/590**[58] **Field of Search** ..... 75/10.19, 10.21, 75/399; 420/590[56] **References Cited****U.S. PATENT DOCUMENTS**

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*Primary Examiner*—Melvyn Andrews*Attorney, Agent, or Firm*—Thorpe North & Western[57] **ABSTRACT**

A fast quench reaction includes a reactor chamber having a high temperature heating means such as a plasma torch at its inlet and a means of rapidly expanding a reactant stream, such as a restrictive convergent-divergent nozzle at its outlet end. Metal halide reactants are injected into the reactor chamber. Reducing gas is added at different stages in the process to form a desired end product and prevent back reactions. The resulting heated gaseous stream is then rapidly cooled by expansion of the gaseous stream.

**23 Claims, 8 Drawing Sheets**